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The Morphology of the Tarsal Sensilla in the Female Mite *Varroa jacobsoni*

T. P. Liu

Bee Diseases Research Laboratory, Agriculture Canada Research Station, Box 29, Beaverlodge, Alberta, Canada, T0H 0C0

Abstract.—The group of hairs at the distal end and dorsal surface of the tarsus, consisted of varying size and shaped sensillae. In the center of this hair group was a pit containing a minute dome-like protrusion centrally located at the bottom. On the rim of this pit were small, fine, and differently shaped pegs measuring 3–4 um in height. The pit was surrounded by six sensillae, two of which were slender, curved, round tipped and porous, three of the remaining four were stout and one had a pointed tip. All pegs and six sensillae were stained with crystal violet, and pores were visible on the walls of the two slender and curved sensillae. Surrounding these small sensillae were 12–16 large hairs measuring 12–79 um in height. Two to three of the large hairs were slender, curved, and round tipped. They were also stained with crystal violet. Seven to eight stout, straight hairs, measuring 16–32 um in height were stained with crystal violet only at the tip. Three to four of the longest hairs measured 68–79 um in height and were not stained with crystal violet.

Introduction

The mite *Varroa jacobsoni* is a serious pest of the honeybee (Ritter, 1981), and although chemical control agents have been developed in Europe, effective control is difficult. Therefore, new approaches such as the use of pheromones and attractants for managing this pest, should be explored. Feeding and reproduction of the mite takes place in the brood cells, and drone larvae are preferred to that of the workers. This preference suggests that there are chemical cues in the drone cells which attract the mite, and it must be assumed that the mite is equipped with sense organs of relatively high specialization. A study of the olfactory system in *V. jacobsoni* would be desirable, since little attention has been given to the morphology and possible function of the different hairs in the sensorial field and tarsal organ (Langhe *et al.*, 1976). This study attempts to describe the variated cuticular morphology of the tarsal sensillae, in the sensorial field at the first pair of legs on the female mite, and determine their possible function.

Materials and Methods

The female mites were collected in Fireburg, West Germany, and kept in 8% EM grade gluteraldehyde (Polyscience, Warrington, U.S.A.). Specimens were prepared for scanning electron microscopy as described in a previous publication (Liu and Liu, 1984).

The crystal violet stain technique of Slifer and Brescia (1960) was employed for testing the permeability of the sensilla as described previously (Liu and Liu, 1984).

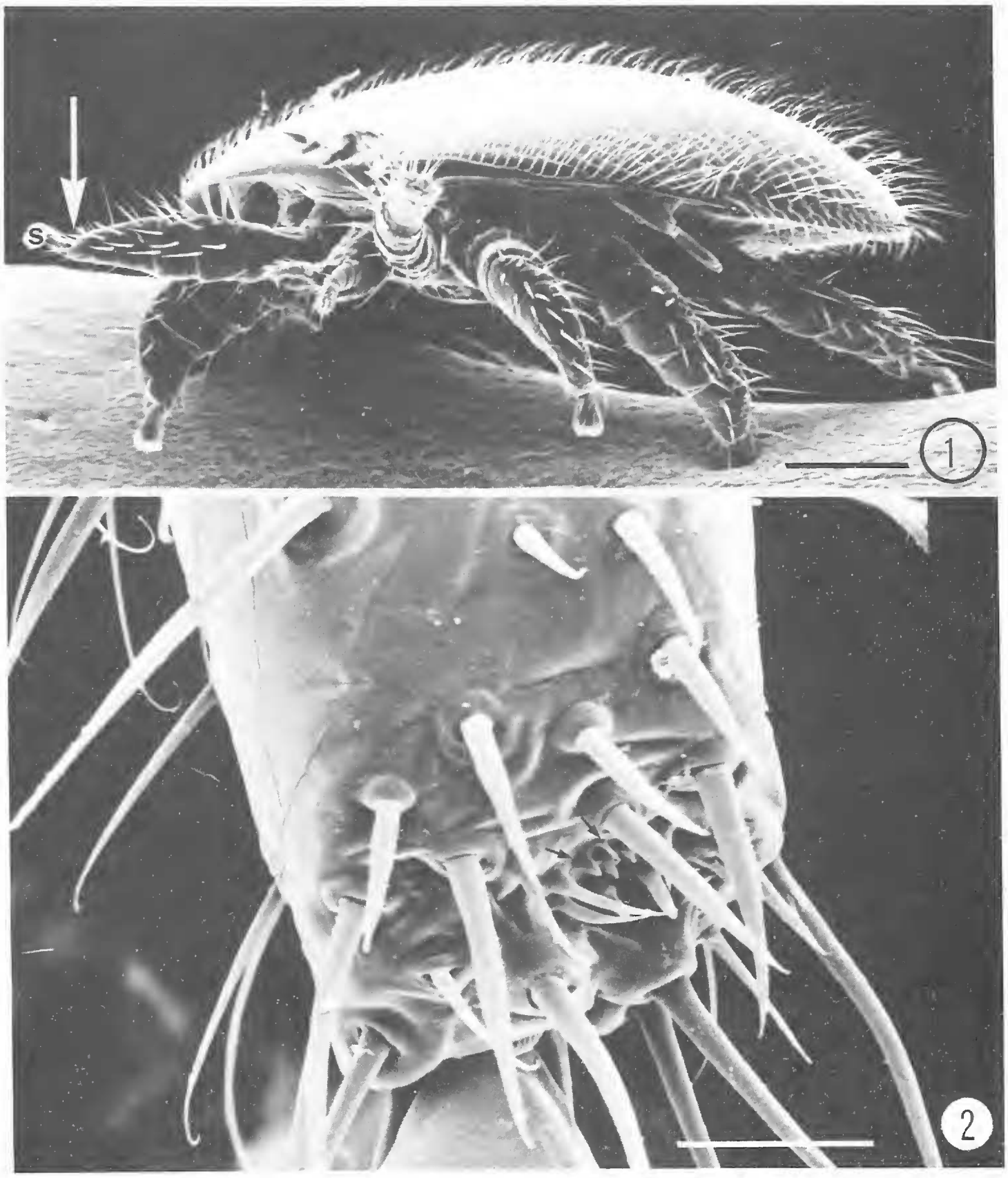
Gluteraldehyde fixed mites were washed with distilled water and again fixed in freshly prepared 5% gluteraldehyde in distilled water, after which they were then washed with distilled water alone. Washed specimens were twice immersed in 0.5% crystal violet in distilled water for 10 and 30 minutes respectively. Mites were removed from the stain, washed with distilled water, and blot-dried with filter paper. Dried mites were immersed in xylene for 60 minutes, and then mounted on glass slides with permount for microscopic examination. The sensilla height was measured from negatives or photographs by use of a video image analysis system equipped with a Kurta series 2 graphic tablet.

Results

There is a group of sensillae ventrally located at the distal end of the tarsus behind the pretarsus (Figs. 1 and 2). In the center of this sensillae group was a pit with a minute dome-like protrusion centrally situated at the bottom with pores visible on its surface (Figs. 3 and 4). The dome-like protrusion was surrounded by five fine smaller pegs 3–4 um in height, and they were situated on the rim of the pit (Figs. 2 and 5). One of these pegs was slender with a pointed tip, while the other was stout with a flat tip. The remaining pegs were stout with pointed tips (Figs. 2 and 5). All pegs stained brightly after 10 minutes in the crystal violet solution. There were six sensillae measuring 5.5–6.3 um in height, surrounding the pit (Figs. 2 and 5). Two of these sensillae were slender, curved, and round tipped (Fig. 5). Pores were visible on their surface (Fig. 6) and their diameter was from 0.08–0.12 um. Of the four remaining sensillae three were stout and one had a pointed tip (Figs. 2 and 5). All six sensillae were readily stained with crystal violet after 10 minutes in the crystal violet solution. There were 12–16 large hairs surrounding the small sensillae (Figs. 2 and 3), 2–3 of them appearing slender and curved, measuring 14–17 um in height. They were stained with crystal violet throughout the whole length, but no pores were visible. Seven to eight stout straight hairs with round tips measured 16–32 um in height. These hairs were stained with crystal violet only at the tip. Three to four of the longest hairs measured 68–79 um in height, but were not stained with crystal violet.

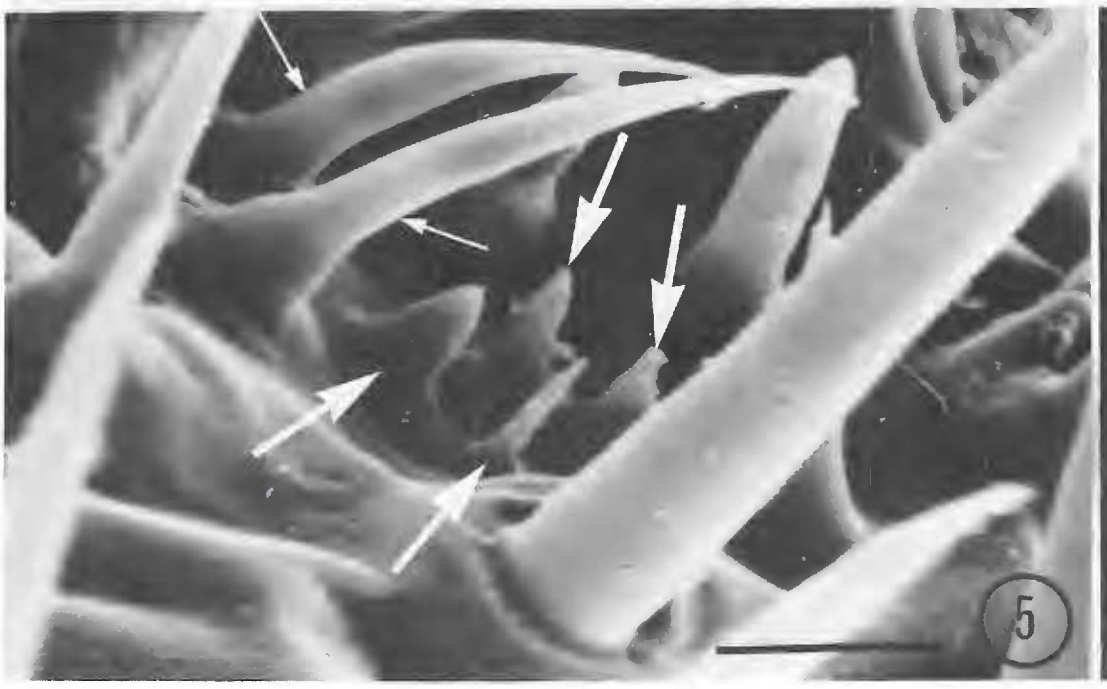
Discussion

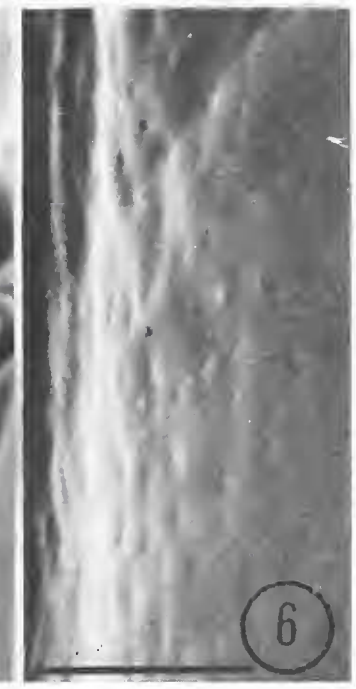
According to Langhe and Natzkii (1977) the tarsus on the first pair of legs of *V. jacobsoni* possess numerous grouped sensillae at the distal end and dorsal surface. This hair group is referred to as the sensorial field, and the tarsal organ is located at its center (Langhe et al., 1976). The present study reveals that sensillae in the sensorial field consists of both thick, and thin walled sensillae, along with longer tactile hair. The dome-like protrusion in the center of the pit may be similar to the coeloconic sense organ of insects (McIver, 1973). In the honeybee, coeloconic sensillae are sensitive to carbon dioxide, temperature, and humidity (Lacher, 1964). The five small pegs on the rim of the pit are thin walled sensillae which resemble the sensilla basiconica of insects. This type of sensillae may have external morphological differences, but all possess a multiporous wall. Therefore, Slifer *et al.* (1959) classified them together. Sensilla basiconica has been observed responding to a variety of chemicals except sex pheromones (Kaissling, 1971; Priesner, 1968; Schneider, 1965; Schneider and Steinbrecht, 1968; Schneider *et al.*, 1964). Slifer *et al.* (1959) also considers this type of sensillae to be the major olfactory organ used for locating odorous food. The six small sensillae surrounding the pit were all stained



Figures 1–2. Figure 1. The sensorial field (arrow) is located at the distal end and dorsal surface of the tarsus, behind the pretarsus (S) sucker. Bar = 20 μm. Figure 2. The centrally located pit displays five small pegs located on the rim (arrows). Bar = 10 μm.

with crystal violet, which readily indicated that they are porous. Pores were also visible on the surface of the two curved sensillae which are different in shape and may resemble the sensilla trichodea (Steinbrecht, 1973; Albert and Seabrook, 1977; Albert *et al*, 1974; Liu and Liu, 1984). This type of sensillae contains pheromone receptors (Steinbrecht, 1973; Albert and Seabrook, 1973; Albert *et al.*, 1974). Two of the larger sensillae in the sensorial field are porous, and the external morphology is also similar to that of the sensillae trichodea. The large hairs which were stained with





Figures 3–6. Figure 3. The sensorial field consists of a hair group which contains sensillae of varying sizes and shapes. In the center of the sensorial field is a pit, a minute dome-like protrusion (arrow) is centrally located at the bottom of the pit, and five small pegs are located on the rim of the pit (shown in Figure 4). There are six small sensillae surrounding the pit itself. Bar = 10 μm. Figure 4. The dome-like protrusion (asterisk) at the bottom of the pit is porous (arrow heads). Small pegs (P) on the rim of the pit. Bar = 2 μm. Figure 5. On the rim of the pit are small pegs (arrows), while outside the rim are small sensillae. Two of these sensillae (small arrows) are slender, curved, round tipped and porous (pores are present on the surface of the two curved sensillae), while the others are stout and blunt tipped (arrowhead). Bar = 5 μm. Figure 6. Pores are present on the surface of the two curved sensillae shown in Figure 5. Bar = 1 μm.

crystal violet only at the blunt tips, indicated the presence of an apical pore. This type of sensillae may resemble the thick walled sensilla chaetica, which functions as a contact receptor (Slifer, 1970). The three longest hairs were not stained with crystal violet, hence indicating that they may be tactile hairs (Slifer, 1979). Langhe *et al.* (1976) suggested that the sensillae in the sensorial field, are thin walled chemoreceptors which may assist the mite in locating its phoretic host and suitable brood cells. The present study indicates that the sensorial field of *V. jacobsoni* consists of different sensillae types which may perform a variety of functions.

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